BRISTLEBOT PHYSICS

Newton's First Law

Definition: An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.
Example: Unless a force is applied to the robot (a push, pull, motor turning) the robot will stay at rest. It will not change direction or speed unless a new force is applied.

Newton's Second Law

Definition: The change in velocity of an object is directly proportional to the amount of force applied to that object.

F = mA Force = mass*Acceleration (Units: Newtons, Pound)

Example: The more force exerted to move an object the faster the object will move. However, if the object is twice as massive twice the force is needed in order to move the object at the same rate. The lighter the bristlebot the less force it needs to move, therefore a light bristlebot is more likely to move faster.

Force

Definition: An influence tending to change the motion of a body or produce motion or stress in a stationary body. Push or Pull.
Example: A person applies a pushing force to open the door. The bristlebot's motors vibration bounces up and down the bristles rapidly apply a pushing force on the ground.

Friction

Definition: The resistance that one surface or object encounters when moving over another.
Example: When a person is walking, there exists friction between the shoe and the ground allowing the person to push off and move forward. The friction between the bristles and ground allow the robot to move in a forward direction.

Engineering

Materials
- Bristlebot Kit (per student)
- Scissors
- 2 Yard Sticks
- Timer
- Tape

Learning Objectives
- How to use creativity and everyday materials to build something useful.
- How to utilize designs and sketches in creating a product.
- Trial and error, learning from previous designs

Indicators

ACTIVITY #1: SPEEDSTER!

Introduction Being able to recognize a problem and design a potential solution is the first step in the development of new and useful products. In this activity, you'll be given a Bristlebot Kit and must get it to travel as fast as possible.

Motivation

After designing and building the robot, you'll participate in a drag race. Your robot needs to reach the end of the course in the fastest time to win. Designing it to go straight (Activity #2) may be a key feature for a winning robot...

Materials

Bristlebot Kit

Timer

Discussion

- Why are new products made and why do innovations take place?
- How can you manipulate your robot? (add/remove things, change surroundings)
- What would trimming the bristles do? (think, don't do)
- What about removing some? (think, don't do)
- Does the number or location of bristles matter? Consider friction and weight.
- Does the surface on which the robot travels matter?
- Would the drag caused by pipe cleaners or something else have an effect?

Activity

1. Envision how force is applied on the surface of the robot, propelling it forward.
2. Come up with at least 3 possible modifications to make your robot go faster.
3. Using tape, make a race track on a table or smooth floor that the robot will travel down.
4. Choose a solution and test.

Investigating Questions

- What materials were the best to use for this project?
- What would you have done differently?
- What other materials could have worked?
- Did planning out your robot design prior to building aid in the construction of the robot?

ACTIVITY #2: STRAIGHT SHOT!

Introduction Use your problem solving skills to make your robot travel as straight as possible.

Learning Objectives

- Learn problem solving through trial and error
- Learn to analyze a problem, brainstorm solutions, and test your design

Materials

Bristlebot

Household objects

Discussion

- How could you modify your robot or its environment to make it move in a straight line?
- Formulate an idea and sketch a picture before construction.
- Keep in mind that there is more than one way to make your robot go straight. Examples are use of pipe cleaners, construction paper, cutting the bristles, creating a bumper that guides the robot down the track, changing the surface it travels...

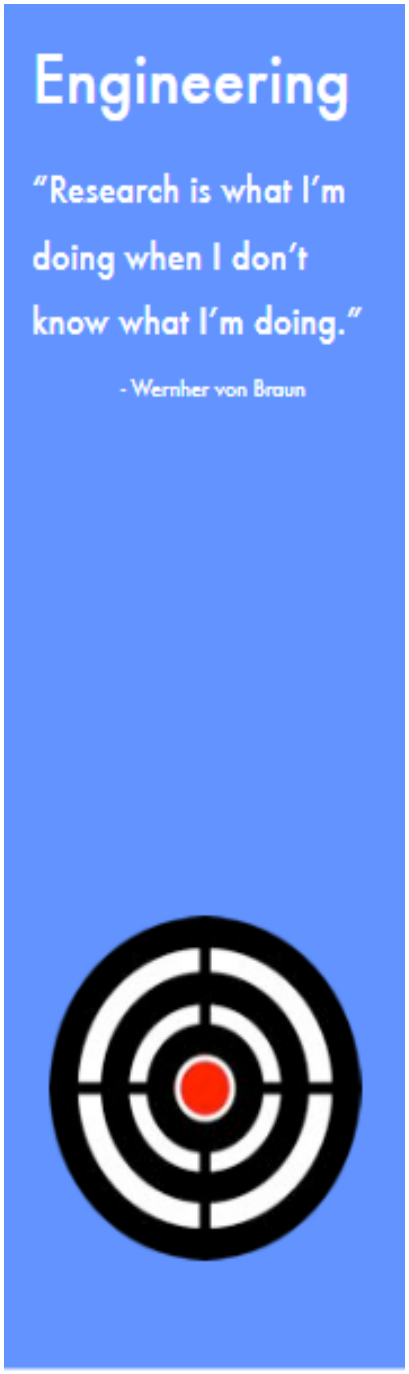
Activity

1. Envision how force is applied on the surface of the robot, propelling it forward.
2. Come up with at least 3 possible modifications.
3. Choose a solution and test on the race track.

Investigating Questions

What modification worked best? Why?

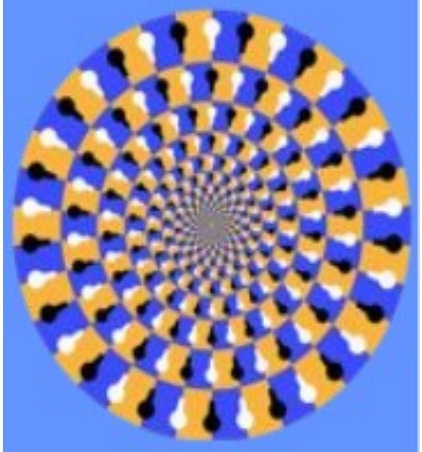
Does weight play a factor? Why or why not?



Engineering

"Each problem that I solved became a rule, which served afterwards to solve other problems."

- Rene Descartes



Indicators

ACTIVITY #3: DONUT!

Introduction Use your problem solving skills to make your robot travel in as tight a circle as possible.

Learning Objectives

- Learn problem solving through trial and error
- Learn to analyze a problem, brainstorm solutions, and test your design

Materials

Bristlebot Kit

Paper plate

Timer

Discussion

- How can you manipulate your robot?
- What would trimming the bristles do? (think, don't do)
- What about removing some? (think, don't do)
- Does the number of bristles matter? Think friction and weight.
- Would the drag caused by pipe cleaners have an effect?
- Does weight on one side or the other matter?

Activity

1. Envision how force is applied on the surface of the robot, propelling it to stay as stationary as possible, or in a circle as long as possible.
2. Come up with at least 3 possible modifications.
3. Choose a solution and test.
4. Flip the paper plate upside down. Test your robot on the surface and time how long it stays there.

Investigating Questions

What modification worked best? Why?

Does weight play a factor? Why or why not?

How does what you did to make your bot do a "Donut" spin compare to what you did in the "Straight Shot" activity?